Pacing Guide

Level 4 Module 3

Earth Systems

Each *PhD Science® TEKS Edition* Level 4 lesson requires 45 minutes of instructional time. This guide is intended for teachers who are providing in-person instruction. This guide presents lesson objectives and activities by concept and multiple pacing options to allow teachers to maximize instructional time while remaining responsive to student needs. Choose one or more options for each lesson. Note that pacing options do not omit parts of lessons.

Pacing Option Key

Lesson Split: This symbol identifies single lessons teachers may split across 2 days.

Cross-Curricular Activity: This symbol identifies parts of lessons teachers may incorporate during instructional time for other content areas, such as English, math, social and emotional learning, and center time. Teachers may implement these parts before or after science instruction; for example, if the class reads a *PhD Science* core text during English instruction, students can discuss the core text during science instruction rather than reading the full text during that time.

Investigation Preparation: This symbol identifies preparation the teacher may do in advance of an investigation. This advance preparation does not interfere with student learning.

Instructional Routine: This symbol identifies opportunities to use alternative instructional routines. See the Implementation Guide for information on instructional routines.

Teacher Think Aloud: This symbol identifies activities that are appropriate for a teacher Think Aloud. Suggested primarily for use during station activities, this option allows completion of these activities as a class. During a teacher Think Aloud, the teacher assumes the role of a student and verbalizes the thought process of a student completing the activity to engage students with intentional questioning techniques. The teacher may also ask students to model appropriate procedures and participate in collaborative conversations.

Shared Media Experience: This symbol identifies media (e.g., videos, images) that the teacher may share with the whole class rather than having students view the media individually or in groups. After students observe the media as a class, they complete an activity.

Focal Point: This symbol identifies parts of lessons teachers should emphasize. For example, in an activity with multiple resources (e.g., videos, texts, charts), a focal point identifies the most important resources, thus ensuring the coherence of the lessons.

Instructional Note: This symbol identifies parts of lessons that have instructional notes that describe time-saving strategies. Examples of such instructional notes are Differentiation supports that provide sentence frames for writing assignments and Teacher Notes that suggest alternative activities.

Module at a Glance

This module contains 33 lessons. Even with lesson splits, this module should take no more than 45 days to complete. This maximum number of days ensures the implementation of all Level 4 modules within a school year that has 150 days of science instruction.

Earth Systems

Anchor Phenomenon: Balinese Rice Farming **Essential Question: How has Balinese rice farming endured for 1,000 years?**	**Recommended Number of Days**	**TEKS and ELPS Alignment**
Concept 1 (Lessons 1–9): Earth's Systems **Focus Question:** Where does fresh water come from? Together, the biosphere, hydrosphere, atmosphere, and geosphere include all the living things, water, rock, soil, and air on Earth.	9–10 days	4.2A, 4.2B, 4.2C, 4.2D, 4.2F, 4.3A, 4.3B, 4.4, 4.7C, 4.8B ELPS: 1C, 3G, 4A
Concept 2 (Lessons 10–18): Interactions of Earth's Systems **Focus Question:** How do water and land interact? Earth's systems continuously interact, and these interactions can cause changes to Earth's water and surface materials.	9–15 days	4.2A, 4.2B, 4.2C, 4.2D, 4.2E, 4.2F, 4.3A, 4.3B, 4.3C, 4.4, 4.5A, 4.5B, 4.7A, 4.7B, 4.8B ELPS: 1C, 2E, 3D, 3E, 3H
Concept 3 (Lessons 19–25): Changes to Earth's Systems **Focus Question:** How do Earth's systems respond to change? Human activities can have positive or negative effects on Earth's systems, and they can disrupt or stabilize systems.	7–12 days	4.2A, 4.2B, 4.2C, 4.2D, 4.2E, 4.2F, 4.3A, 4.3B, 4.3C, 4.4, 4.7A, 4.7B, 4.7C, 4.8A, 4.9A, 4.9B ELPS: 1C, 2F, 3E, 4A, 4E
Application of Concepts (Lessons 26–30): Engineering Challenge **Phenomenon Question:** How can we apply our knowledge of Earth's systems to conserve fresh water? Individuals and communities can apply their knowledge of the interaction of Earth's systems to help protect resources and environments.	5 days	4.1B, 4.2A, 4.2B, 4.2C, 4.2D, 4.2E, 4.2F, 4.3A, 4.3B, 4.3C, 4.4, 4.7C, 4.8B ELPS: 3E, 3G
Application of Concepts (Lessons 31–33): End-of-Module Socratic Seminar, Assessment, and Debrief **Essential Question:** How has Balinese rice farming endured for 1,000 years? Earth is composed of four continuously interacting subsystems that can be positively or negatively affected by human activity.	3 days	4.2D, 4.7A, 4.7B, 4.7C, 4.8B, 4.9A, 4.9B ELPS: 3F

Year at a Glance

This year at a glance chart shows where all three modules fit in a year. To ensure completion of each module, it is recommended to teach science five days a week.

Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Module 1			Module 2			Module 3				

Module 3: Earth Systems

Concept 1: Where does fresh water come from? 9–10 days

Focus Standards

4.7C Identify and classify Earth's renewable resources, including air, plants, water, and animals, and nonrenewable resources, including coal, oil, and natural gas, and the importance of conservation.

4.8B Describe and illustrate the continuous movement of water above and on the surface of Earth through the water cycle and explain the role of the Sun as a major source of energy in this process.

Lessons 1–3: Balinese Rice Farming			Lessons 4–5: Earth's Water
Lesson 1: Develop an initial model of a farm.	**Lesson 2:** Analyze global rice consumption and production data.	**Lesson 3:** Model the movement of water through a Balinese rice farm.	**Lesson 4:** Analyze data on the amounts and distribution of fresh water and salt water on Earth.
Use Differentiation note in Reflect on the Biosphere.	Think aloud first data table in Analyze Global Rice Consumption and Production.	Use an alternative collaborative conversation routine in Land.	Use an alternative instructional routine in Launch. Use a timer to pace the coloring of grids in Analyze Water Distribution Data. Use Differentiation note in Analyze Water Distribution Data.

Concept 1: Where does fresh water come from? (continued)

Lessons 4–5: Earth's Water	Lessons 6–9: The Movement of Water		
Lesson 5: Explore marine ecosystems.	**Lesson 6:** Use a model to track the movement of water through a system.	**Lesson 7:** Use a model to explain the movement of water in a system.	**Lesson 8:** Describe how atmospheric conditions result in cloud formation.
Focus on four of the six marine ecosystem live camara feeds in Launch. Think aloud one station in Explore Marine Ecosystems.		Use an alternative instructional routine in Land. Use English Language Development note in Land.	Use an alternative collaborative conversation routine in Compare Model to Natural System.

Lessons 6–9: The Movement of Water
Lesson 9: Gather evidence to explain how water moves through Earth's atmosphere.
Day 1: Launch through Explore Relationships in Earth's Atmosphere **Day 2:** Update Anchor Chart and Anchor Model through Land
Conceptual Checkpoint

Concept 2: How do water and land interact? 9–15 days

Focus Standards

4.5A Measure, compare, and contrast physical properties of matter, including mass, volume, states (solid, liquid, gas), temperature, magnetism, and the ability to sink or float.

4.5B Compare and contrast a variety of mixtures, including solutions.

4.7A Examine properties of soils, including color and texture, capacity to retain water, and ability to support the growth of plants.

4.7B Observe and identify slow changes to Earth's surface caused by weathering, erosion, and deposition from water, wind, and ice.

4.8B Describe and illustrate the continuous movement of water above and on the surface of Earth through the water cycle and explain the role of the Sun as a major source of energy in this process.

Lesson 10: Rain Shadows	**Lessons 11–12: Tracking Water**		**Lessons 13–15: Rice Farming in Texas**
Lesson 10: Develop a model to explain how the interactions of Earth's systems can influence weather patterns.	**Lesson 11:** Model how Earth's materials affect what happens to precipitation when it reaches the geosphere.	**Lesson 12:** Investigate how water interacts with different surface materials.	**Lesson 13:** Identify the necessary conditions for growing rice.
Day 1: Launch through Explore Other Mountain Ranges **Day 2:** Determine Effects of Rain Shadows on the Biosphere through Land	**Day 1:** Launch through Model Mount Batur **Day 2:** Examine Surface Materials through Land	**Day 1:** Launch through Investigate Surface Materials **Day 2:** Explore Groundwater through Land	**Day 1:** Launch through Compare Temperature and Rainfall Data. **Day 2:** Locate Sources of Fresh Water through Land
Use a timer to pace the drawing of initial models in Examine Effects of the Cascade Range.	Complete the first 4 steps in Lesson 11 Resource B before the lesson.	Use Differentiation note in Investigate Surface Materials.	Use Differentiation note in Compare Temperature and Rainfall Data.
Use an alternative instructional routine in Determine Effects of Rain Shadows on the Biosphere.	Think aloud one station in Examine Surface Materials.	Measure weight of each material and volume of water for each group to use in Investigate Surface Materials before the lesson.	Use an alternative collaborative conversation routine in Compare Temperature and Rainfall Data.

Concept 2: How do water and land interact? (continued)

Lessons 13–15: Rice Farming in Texas		Lessons 16–18: Coastal Landforms	
Lesson 14: Examine soil properties to evaluate a soil's suitability for growing rice.	**Lesson 15:** Use evidence to support a claim about which Colorado County location is more suitable for growing rice.	**Lesson 16:** Gather evidence to make a claim about how oceans shape landforms.	**Lesson 17:** Gather evidence to make a claim about how glaciers shape landforms.
		Day 1: Launch through Model a Coastline **Day 2:** Discuss Coastline Investigation through Land Use an alternative collaborative conversation routine in Discuss Coastline Investigation. Use Differentiation note in Land.	Use Teacher Note in Model Glacial Movement.

Lessons 16–18: Coastal Landforms
Lesson 18: Explain that Earth's systems are constantly interacting.
Day 1: Launch through Update Anchor Chart **Day 2:** Conceptual Checkpoint through Land

Concept 3: How do Earth's systems respond to change? 7–12 days

Focus Standards

4.7A Examine properties of soils, including color and texture, capacity to retain water, and ability to support the growth of plants.

4.7B Observe and identify slow changes to Earth's surface caused by weathering, erosion, and deposition from water, wind, and ice.

4.7C Identify and classify Earth's renewable resources, including air, plants, water, and animals, and nonrenewable resources, including coal, oil, and natural gas, and the importance of conservation.

4.8A Measure, record, and predict changes in weather.

4.9A Investigate that most producers need sunlight, water, and carbon dioxide to make their own food, while consumers are dependent on other organisms for food.

4.9B Describe the flow of energy through food webs, beginning with the Sun, and predict how changes in the ecosystem affect the food web.

Lessons 19–21: The Dust Bowl			**Lessons 22–23: Great Plains Ecosystem**
Lesson 19: Analyze precipitation data during the Dust Bowl.	**Lesson 20:** Plan an investigation to explore factors that may have contributed to the Dust Bowl.	**Lesson 21:** Model the effects of factors that may have contributed to the Dust Bowl.	**Lesson 22:** Identify the flow of energy through a food chain.
Day 1: Launch through Define a Disrupted System **Day 2:** Analyze Precipitation Data through Land	**Day 1:** Launch through Explore Other Factors That Led to Dust Bowl **Day 2:** Plan Investigations through Land	**Day 1:** Launch through Discuss Contributing Factors **Day 2:** Compare Dust Bowl Farming with Balinese Rice Farming through Land	Use an alternative collaborative conversation routine in Identify Energy Source for Plants.
Use inline English Language Development note in Define a Disrupted System.	Think aloud claims and reasoning chart in Explore Other Factors That Led to Dust Bowl.	Use an alternative collaborative conversation routine in Discuss Contributing Factors.	Use first Differentiation note in Explore Different Food Chains.
Use Differentiation note in Analyze Precipitation Data		Use Differentiation note in Discuss Contributing Factors	Use second Differentiation note in Explore Different Food Chains.

<table>
<tr><th colspan="3">Concept 3: How do Earth’s systems respond to change? (continued)</th></tr>
<tr><th>Lessons 22–23: Great Plains Ecosystem</th><th colspan="2">Lessons 24–25: Sustainable Agriculture</th></tr>
<tr><td>Lesson 23: Identify how changes in an ecosystem affect its food web.</td><td>Lesson 24: Model a sustainable agriculture practice to explain how human activity can affect a farming system.</td><td>Lesson 25: Evaluate the success of farming practices introduced on Bali during the Green Revolution.</td></tr>
<tr><td rowspan="2">Day 1: Launch through Create a Food Web
Day 2: Describe Changes in the Great Plains Ecosystem through Land
Use first Differentiation note in Create a Food Web.
Use second Differentiation note in Create a Food Web.</td><td rowspan="2">Use a timer to pace each round of growing seasons in Model Crop Rotation.</td><td>Day 1: Launch through Update Anchor Chart
Day 2: Conceptual Checkpoint through Land</td></tr>
<tr><td>Conceptual Checkpoint</td></tr>
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Engineering Challenge: How can we apply our knowledge of Earth's systems to conserve fresh water? — 5 days

Focus Standards

4.7C Identify and classify Earth's renewable resources, including air, plants, water, and animals, and nonrenewable resources, including coal, oil, and natural gas, and the importance of conservation.

4.8B Describe and illustrate the continuous movement of water above and on the surface of Earth through the water cycle and explain the role of the Sun as a major source of energy in this process.

Lessons 26–30: Water Conservation			
Lesson 26: Apply the engineering design process to design and test a sustainable irrigation system.	**Lesson 27:** Apply the engineering design process to design and test a sustainable irrigation system.	**Lesson 28:** Apply the engineering design process to design and test a sustainable irrigation system.	**Lesson 29:** Apply the engineering design process to design and test a sustainable irrigation system.
Engineering Challenge	**Engineering Challenge**	**Engineering Challenge**	**Engineering Challenge**

Lessons 26–30: Water Conservation
Lesson 30: Apply the engineering design process to design and test a sustainable irrigation system.
Engineering Challenge

Application of Concepts: How has Balinese rice farming endured for 1,000 years? — 3 days

Focus Standards

4.7A Examine properties of soils, including color and texture, capacity to retain water, and ability to support the growth of plants.

4.7B Observe and identify slow changes to Earth's surface caused by weathering, erosion, and deposition from water, wind, and ice.

4.7C Identify and classify Earth's renewable resources, including air, plants, water, and animals, and nonrenewable resources,

including coal, oil, and natural gas, and the importance of conservation.

4.8B Describe and illustrate the continuous movement of water above and on the surface of Earth through the

water cycle and explain the role of the Sun as a major source of energy in this process.

4.9A Investigate that most producers need sunlight, water, and carbon dioxide to make their own food, while consumers are dependent on other organisms for food.

4.9B Describe the flow of energy through food webs, beginning with the Sun, and predict how changes in the ecosystem affect the food web.

Lessons 31–33: The Sinking City		
Lesson 31: Explain how human activities affect Earth's systems and processes.	**Lesson 32:** Explain how human activities affect Earth's systems and processes.	**Lesson 33:** Explain how human activities affect Earth's systems and processes.
Use English Language Development note in Engage in Socratic Seminar.		
Socratic Seminar	**End-of-Module Assessment**	**End-of-Module Debrief**

Texas Essential Knowledge and Skills (TEKS)

Focus Standards	
4.1	Scientific investigation and reasoning. The student conducts classroom and outdoor investigations following home and school safety procedures and environmentally appropriate practices. The student is expected to
4.1A	demonstrate safe practices and the use of safety equipment as described in Texas Education Agency–approved safety standards during classroom and outdoor investigations using safety equipment, including safety goggles or chemical splash goggles, as appropriate, and gloves, as appropriate; and
4.1B	make informed choices in the use and conservation of natural resources and reusing and recycling of materials such as paper, aluminum, glass, cans, and plastic.
4.2	Scientific investigation and reasoning. The student uses scientific practices during laboratory and outdoor investigations. The student is expected to
4.2A	plan and implement descriptive investigations, including asking well defined questions, making inferences, and selecting and using appropriate equipment or technology to answer his/her questions;
4.2B	collect and record data by observing and measuring, using the metric system, and using descriptive words and numerals such as labeled drawings, writing, and concept maps;
4.2C	construct simple tables, charts, bar graphs, and maps using tools and current technology to organize, examine, and evaluate data;
4.2D	analyze data and interpret patterns to construct reasonable explanations from data that can be observed and measured;
4.2E	perform repeated investigations to increase the reliability of results; and
4.2F	communicate valid oral and written results supported by data.
4.3	Scientific investigation and reasoning. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to
4.3A	analyze, evaluate, and critique scientific explanations by using evidence, logical reasoning, and experimental and observational testing;
4.3B	represent the natural world using models such as the water cycle and stream tables and identify their limitations, including accuracy and size; and
4.3C	connect grade-level appropriate science concepts with the history of science, science careers, and contributions of scientists.
4.4	Scientific investigation and reasoning. The student knows how to use a variety of tools, materials, equipment, and models to conduct science inquiry. The student is expected to
4.4	collect, record, and analyze information using tools, including calculators, microscopes, cameras, computers, hand lenses, metric rulers, Celsius thermometers, mirrors, spring scales, balances, graduated cylinders, beakers, hot plates, meter sticks, magnets, collecting nets, and notebooks; timing devices; and materials to support observation of habitats of organisms such as terrariums and aquariums.

Investigation and Reasoning Standards	
4.5	Matter and energy. The student knows that matter has measurable physical properties and those properties determine how matter is classified, changed, and used. The student is expected to
	4.5A measure, compare, and contrast physical properties of matter, including mass, volume, states (solid, liquid, gas), temperature, magnetism, and the ability to sink or float; and
	4.5B compare and contrast a variety of mixtures, including solutions.
4.7	Earth and space. The students know that Earth consists of useful resources and its surface is constantly changing. The student is expected to
	4.7A examine properties of soils, including color and texture, capacity to retain water, and ability to support the growth of plants;
	4.7B observe and identify slow changes to Earth's surface caused by weathering, erosion, and deposition form water, wind, and ice; and
	4.7C identify and classify Earth's renewable resources, including air, plants, water, and animals, and nonrenewable resources, including coal, oil, and natural gas, and the importance of conservation.
4.8	Earth and space. The student knows that there are recognizable patterns in the natural world and among the Sun, Earth, and Moon system. The student is expected to
	4.8A measure, record, and predict changes in weather; and
	4.8B describe and illustrate the continuous movement of water above and on the surface of Earth through the water cycle and explain the role of the Sun as a major source of energy in the process.
4.9	Organisms and environments. The student knows and understand that living organisms within an ecosystem interact with one another and with their environment. The student is expected to
	4.9A investigate that most producers need sunlight, water, and carbon dioxide to make their own food, while consumers are dependent on other organisms for food; and
	4.9B describe the flow of energy through food webs, beginning with the Sun, and predict how changes in the ecosystem affect the food web.